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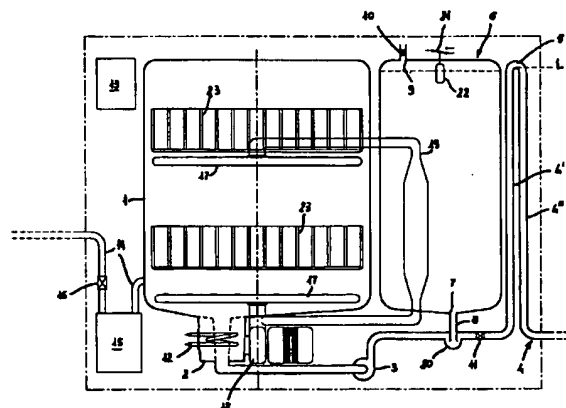
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(54) **Washing machine with a multi-function water reservoir**

(57) Dishwashing machine comprising a reservoir (6) communicating with the washing tank (1) through a lower aperture (7) connected to the delivery side of a drain pump (3). Furthermore, the reservoir (6) comprises an upper aperture (9) capable of communicating with the outside ambient through a valve (10) which is controlled by the programme sequence control switch (13) of the machine so as to open during a pre-determined water discharge phase to enable the reservoir (6) to be filled by the water being let out from the tank (1); to temporarily close so as to prevent said reservoir (6) from emptying after said water discharge phase; and to finally open again so as to enable the water stored in the reservoir (6) to flow back into the washing tank (1), through the lower aperture (7) and the pump (3), to be used during said subsequent phase of the washing process.



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Description

The present invention refers to a washing machine provided with a multi-function water reservoir adapted to enable water and, possibly, heat to be recovered in view of reaching an overall energy saving effect.

Dishwashing machines are known, so as disclosed for instance by EP-A-0 669 097, which are provided with a reservoir adapted to store the water from the last rinse phase in view of using it again as process water in the washing phase of a subsequent washing cycle.

Arrangements for use in conjunction with clothes washing machines are also known, so as for instance disclosed in EP-A-0 287 990, in which not only water, but also the heat of previously heated-up water can be recovered. In particular, the heat of hot water being discharged, being sent to the outlet of the machine, can be transferred by means of a heat exchanger to the fresh water being filled in a washing machine for carrying out a subsequent washing cycle.

However, all such prior-art solutions for recovering water and/or heat are undesirably complicated and unreliable, mainly owing to their requiring a large number of actuators, with related control means, to control the operation of at least a water storage reservoir and the energy recovery system associated thereto.

It therefore is a main purpose of the present invention to provide a washing machine provided with a multi-function water reservoir adapted to perform an effective energy recovery duty, in particular a water and, possibly, heat recovery duty, in a simple manner.

It is a further purpose of the present invention is to provide a washing machine of the above cited kind, which has a construction and a structure which is particularly simple and reliable and, at the same time, is very versatile in its operation.

According to the invention, these aims are reached in a washing machine with a multi-function water reservoir incorporating the characteristics as recited in the appended claims.

The characteristics and the advantages of the present invention will anyway be more readily understood from the description which is given below by way of non-limiting example. The description is given with reference to the accompanying drawing, in which the single Figure appearing there is a schematical view of the main component parts of the washing machine according to a preferred embodiment of the present invention.

In a preferable manner, the washing machine is a dishwashing machine of the domestic type comprising a washing tank 1 provided in its bottom portion with a water collecting sump 2, the water being capable of being heated up by means of an electric heating element 12, or similar means, controlled by a programme sequence control switch 13.

In a *per se* known manner, the washing tank 1 houses at least a rotating spray arm 17 adapted to be supplied by a circulation pump 18, through at least a

connection conduit 19, with water taken from said sump 2 in view of spraying such a water on to the washload items that are arranged in appropriate basket 23.

The sump 2 communicates with the suction side of a drain pump 3, the delivery side of which is connected to a drain conduit 4. In a preferable manner, the drain conduit 4 has a siphon-trap type conformation with an upwards sloping section 4' and a downwards sloping section 4". Therefore, the drain conduit 4 extends with an overflow device 5 having a pre-determined spilling level L.

The dishwashing machine is further provided with at least a reservoir 6 arranged preferably outside the washing tank, eg. in the hollow space provided between the same tank and the outer casing (not shown) of the machine. This reservoir 6 has a substantially closed construction and comprises at least a lower aperture 7 through which it communicates with the washing tank 1. In particular, according to a feature of the invention said lower aperture 7 of the reservoir 6 is connected with a pipe 8 to the delivery side of the drain pump 3, through which the reservoir communicates with the washing tank. In a preferred manner, the pipe 8 comprises a siphon-trap type arrangement 20, the purpose of which is to prevent the reservoir 6 from unduly self-emptying, as this will be better explained further on. Furthermore, downstream of the connection of the delivery side of the pump 3 with the pipe 8 there is preferably provided a non-return or similar check valve 11 in the drain conduit 4.

The reservoir 6 further comprises at least an upper aperture 9 adapted to communicate with the outside ambient through valve means, such as for instance an appropriate electromagnetic valve 10, that are controlled by the programme sequence control switch 13 of the machine.

In a preferred manner, the upper aperture 9 is situated at a level which is at least equal to the afore mentioned spilling or overflow level L. Alternatively, regardless of the position of said upper aperture 9, the valve 10 is situated at a level which is at least equal to the spilling or overflow level L.

In a *per se* known manner, the washing tank 1 is capable of being supplied with water from the mains in view of carrying out, as controlled by the programme sequence control switch 13, operation cycles comprising at least a washing phase and/or at least a rinsing phase. To this purpose, the machine comprises a water fill conduit 14 provided with a water softener arrangement 15 (with associated hydraulic regeneration circuit of a *per se* known type and not shown here) and an electromagnetic water fill valve 16 controlled by said programme sequence control switch 13.

As it will be explained in greater detail further on, the reservoir 6 is adapted to store at least a part of the water from at least one of the above cited process phases in view of reusing it during a subsequent process phase. The general operating mode of the machine is therefore substantially known, so that only the operat-

ing characteristics and features that are peculiar to the machine according to the present invention will be described below by way of non-limiting example.

To this purpose, let us assume that the dishwashing machine has carried out a rinsing phase in which the washload items have been rinsed in a substantially traditional phase, so that the water collecting sump 2 is full of preferably heated-up water. Furthermore, the valve 10 is closed and, as a result, as this will be more readily understood further on, the reservoir 6 is substantially full of air.

The rinsing phase is followed by a water drain phase determined by the energization of the pump 3 which tends to send toward the outlet 4, through the non-return valve 11, the water contained in the sump 2. According to a feature of the invention, during such a drain phase the programme sequence control switch 13 causes the valve 10 (and, as a result, the aperture 9 of the reservoir) to open, so that at least a part of the water under pressure at the delivery side of the pump 3 is free to flow into the reservoir 6 through the pipe 8 and the lower aperture 7.

It should be noticed that such an opening of the valve 10 can preferably take place at the beginning of the drain phase, when the upwards sloping section 4' of the drain conduit is substantially full of residual water due to the presence of the non-return valve 11. The water under pressure at the delivery side of the pump 3 therefore finds a preferential flow-path through the aperture 7 of the reservoir 6, as long as the pressures in the drain conduit 4 and the reservoir 6 do not become equivalent.

In any case, during said drain phase at least a part of the water removed from said collecting sump 2 flows to substantially fill up the reservoir 6, which will preferably be given a capacity corresponding to at least the volume of the water discharged during said drain phase. It will of course be appreciated that such a filling of the reservoir 6 is enabled not only by the operation of the pump 3 and the opening of the valve 10 (which allows air to be vented outside), but also by the fact that the drain conduit 4 has substantially an overflow or spilling level L, as this has been described above. On the other hand, the overflow arrangement 5 allows any possible excess water to be discharged, so that it effectively and advantageously prevents water from flowing out through the upper aperture 9 of the reservoir 6.

At the end of the drain phase, preferably immediately before the pump 3 is de-energized, the programme sequence control switch 13 commands the valve 10 to close temporarily, so that the reservoir 6 starts to behave like a bell, or pressure accumulator, having its top portion sealed hermetically. As a result, when the pump 3 does not operate, the water stored in the reservoir 6 will remain trapped and confined there due to negative pressure effect, so that it will be unable to flow out through the lower aperture 7 which, to this purpose, is preferably associated to the siphon-trap arrangement 20 of the pipe 8, as this has already been

illustrated.

It should be noticed that, as long as the valve 10 stays in its closed state for the recovered water to be stored in the reservoir 6, the operation of the dishwashing machine can go on to carry out other functions in a traditional manner. For instance, the pump 3 may be operated, without this involving or affecting the water stored in the reservoir 6, to discharge, ie. to send to the outlet 4, the water that has been used for traditionally "flushing" the ion-exchange resins of the water softener 15. In fact, the water sent to the outlet 4 and the water stored in the reservoir 6 remain substantially separated dynamically from each other thanks to the presence of the siphon-trap arrangement 20 which is provided in correspondence of the bottom of the reservoir 6.

According to the present invention, the reservoir 6 will only be able to be emptied when the programme sequence control switch 13, for instance in view of carrying out a washing phase in a subsequent operating cycle of the machine, commands the valve 10 to reopen, thereby enabling air to flow into the reservoir 6 through the upper aperture 9 thereof. The water that had been previously stored in the reservoir 6 can therefore flow by gravity back into the washing tank 1, in particular into the sump 2, through the lower aperture 7, the associated pipe 8 and the pump 3, which is not operating in this moment.

In this manner, substantially clean water can be practically recovered in view of it being reused to carry out a subsequent process or operating phase. This is actually a *per se* known feature, as this has already been explained. According to the present invention, however, the possibility is given for the phases of filling the reservoir 6 with recovered water, keeping the recovered water duly stored in said reservoir 6, and re-using the same water in a subsequent operating or process phase of the machine, to be controlled by making use of a single electromagnetic valve 10, or similar means, which is simply actuated by the programme sequence control switch of the machine in combination with the drain pump 3. A particularly advantageous feature is furthermore given by the fact that said valve 10 does never enter into contact with the water and, as a result, with soil particles that can impair its correct operation. Therefore, the entire washing machine according to the present invention is particularly simple, reliable and cost-effective.

It will of course be appreciated that the afore described washing machine may undergo a number of modifications without departing from the scope of the present invention.

For instance, as either an alternative or an addition to the afore described operation of the machine, the possibility arises for water to be recovered from any different process or operating phase of the machine in view of re-using it in any different process or operating phase carried out by the machine subsequently, according to the actual needs. To this purpose, all it takes to do that is to set the programme sequence control switch 13

of the machine so that it will command the valve 10 to be actuated in the afore described manner in corresponding periods or moments of the operating cycle being performed and/or subsequent operating cycles. Setting the programme sequence control switch in such a manner is an operation which is *per se* within the ability of anyone skilled in the art.

According to another feature of the present invention, at least a part of the piping 19 associated to the rotating spray arm 17 is in a heat-exchange relation with the reservoir 6. For instance, said piping 19 may be arranged so as to run in close contact with the reservoir 6. This embodiment of the invention may prove particularly advantageous in a domestic dishwashing machine of the traditional type adapted to perform at least a rinsing phase with cold water between a washing phase and a final rinsing phase carried out with heated-up water. As generally known, such a final hot-water rinsing phase is also aimed at heating up the washload items in view of enabling them to more effectively dry up subsequently.

In particular, in such an embodiment the programme sequence control switch 13 can be set to actuate the valve 10, in a manner similar to the afore described one, so as to enable at least a part of the heated-up water used in a washing phase to be stored in the reservoir 6. As a result, the cold water supplying the rotating spray arm 17 during one or more subsequent rinsing phases is heated, while flowing along the piping 19, by exchanging heat with the hot water stored in the reservoir 6. Such a heating effect would of course correspondingly reduce the amount of thermal energy required to heat up the washload items during the final rinsing phase. Quite obviously, it will be possible for the washing water so stored in the reservoir 6 to be sent back to the tank 1 and, then, to the outlet 4 in any appropriate period or moment, eg. before the hot-water rinsing phase. This would enable the reservoir 6 to be ready to temporarily recover and store also the hot water from said rinsing phase, as this has been described previously.

A similar thermal energy recovery effect may be obtained by arranging the reservoir 6 in a heat-exchange relation with the washing tank 1, eg. by arranging said reservoir in close contact with said tank.

According to a further feature of the present invention, the multi-function reservoir 6 may be used also to perform a volumetric (and therefore advantageously accurate) control of the water being filled into the tank 1 at the beginning of each operating phase, although the same reservoir 6 is not actually a part of the water supply circuitry 14-16 of the machine. To such an aim, all it takes is to provide the reservoir 6 with a simple level control arrangement adapted to cause the electromagnetic water-inlet valve 16 to close when the water in the reservoir reaches up to a pre-determined level corresponding to the desired volume of water. Such a level control arrangement may be for instance of the type comprising a pressure switch or even a micro-switch 21

controlled by a float 22, as this is described in the afore cited EP-A-0 669 097.

In a preferred embodiment, in order to carry out a water filling phase the programme sequence control switch 13 commands the electromagnetic valve 16 to open and then (at least in the final part of said water filling phase) causes the valve 10 to open and at the same time energizes the drain pump 3. The water filled into the tank 1 collects therefore in the reservoir 6 as this has been described previously. When the water in the reservoir 6 reaches up to the afore cited pre-determined level, the level control arrangement 21, 22 causes (through the programme sequence control switch 13) the electromagnetic water-inlet valve 16 to close and the drain pump 3 to be de-energized. As a result, since the valve 10 is open, the water collected in the reservoir 6 is able to flow back into the sump 2 by passing through the aperture 7, the pipe 8 and the pump 3, as this has already been described. At this point, the valve 10 can be closed again in order to restore the machine in its most appropriate operating state.

It will be appreciated that the washing machine may be of a different type, such as for instance a clothes washing machine.

Claims

1. Washing machine comprising a washing tank connected to a drain conduit through a pump and capable of being supplied with water to carry out, under the control of a programme sequence control switch, operating cycles comprising at least a washing phase and/or at least a rinsing phase, as well as at least a water drain phase, said machine further comprising at least a reservoir communicating with the tank through at least a lower aperture and adapted to store at least a part of the water from at least one of said operating phases in view of a re-utilization thereof during a subsequent operating phase of the machine, **characterized in that**
 - said lower aperture (7) of the reservoir (6) is connected to the delivery side of the pump (3), through which it communicates with the tank (1);
 - the reservoir (6) comprises at least an upper aperture (9) adapted to communicate with the outside ambient through valve means (10);
 - said valve means (10) are controlled by the programme sequence control switch (13) so as to open during at least a pre-determined drain phase to enable said reservoir (6) to be substantially filled with the water being let out of the tank (1), as well as to temporarily close to prevent the water stored in the reservoir (6) from escaping therefrom after said drain phase, and finally to open again so as to ena-

ble the water stored in the reservoir (6) to flow back into the washing tank (1) through said lower aperture (7) and said pump (3) for said subsequent operating phase to be carried out.

2. Washing machine according to claim 1, **characterized in that** the drain conduit (4) extends to include an overflow arrangement (5) having a pre-determined spilling level (L), said upper aperture (9) of the reservoir (6) being situated at a level which is at least equal to said pre-determined overflow level (L). 5
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3. Washing machine according to claim 1, **characterized in that** the drain conduit (4) extends to include an overflow arrangement (5) having a pre-determined spilling level (L), said valve means (10) being situated at a level which is at least equal to said pre-determined overflow level (L). 15
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4. Washing machine according to claim 1, **characterized in that** said reservoir (6) has a capacity which is at least equal to the volume of water discharged from the washing tank (1) during said pre-determined drain phase. 25
5. Washing machine according to claim 1, **characterized in that** the drain conduit (4) comprises, downstream of the connection between the lower aperture (7) of the reservoir (6) and the delivery side of the pump (3), non-return valve means (11). 30
6. Washing machine according to claim 1, **characterized in that** said lower aperture (7) of the reservoir (6) is connected to the delivery side of the pump (3) through a pipe (8) comprising a siphon-trap arrangement (20) adapted to prevent the water stored in the reservoir (6) from unduly escape therefrom. 35
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7. Washing machine according to claim 1, **characterized in that** said reservoir (6) is in a heat-exchange relation with the washing tank (1). 45
8. Washing machine according to claim 1, wherein the washing tank houses means that are adapted to spray onto the washload items water being circulated through a connecting conduit, **characterized in that** at least a portion of said conduit (19) is in a heat-exchange relation with said reservoir (6). 50
9. Washing machine according to claim 1, wherein the programme sequence control switch (13) is adapted to control at least a water filling phase by commanding a water inlet valve (16) of a water-supply conduit (14) connected to the tank (1) to open, **characterized in that** the programme sequence control switch (13) is adapted to command said valve means (10) to open and said pump (3) to be 55

energized at least during the final part of said water filling phase, as well as said water inlet valve (16) to close and said pump (3) to be de-energized when the water in the reservoir (6) reaches up to a pre-determined level, so that the water in the reservoir can then flow back into the tank (1) in a volumetrically metered quantity.

